PROTON-DEUTERON SCATTERING USING PHOTOGRAPHIC TECHNIQUES

BY

FRANKLIN ALANSON RODGERS

B.S., Bradley University, 1944

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN PHYSICS
IN THE GRADUATE COLLEGE OF THE
UNIVERSITY OF ILLINOIS,
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R. UNIV. BIBLIOTHEEK LEIDEN

PROTON-DEUTERON SCATTERING USING PHOTOGRAPHIC TECHNIQUES

The differential cross section for proton-deuteron scattering has been determined for 9.88 Mev incident deuterons obtained from the University of Illinois cyclotron. The deuterons were scattered by hydrogen gas at a pressure of about 5 cm of mercury in a chamber designed to use nuclear track photographic plates as detectors.

The scattered particles were detected by six 1 x 3 inch Ilford type C-2 nuclear track plates mounted on a brass cylinder so that the plane of the emulsion and the long edge of the plate were parallel to the unscattered deuteron beam. An annular slit in front of this cylinder was so designed that it would allow simultaneous registration of particles scattered at angles from 12.5° to 65°. The position of a track on the plate and the position of the plate relative to the annular slit determined the angle of scattering. The undeflected deuterons were collected in a Faraday cage separated from the scattering system by a Dural foil and the current to this Faraday cage was integrated by a low current charge integratnig circuit. A 19 mg/cm^2 aluminum foil was placed over that part of the photographic emulsion which registered deuterons as well as protons. This reduced the range of the tracks in the emulsion to a point where the protons could easly be distinguished from the deuterons. The recoil protons were the only particles counted.

In order to allow simultaneous registration at many polar angles the annular slit had to be designed in such a way that particles could, to a certain extent, penetrate through the edges of the slit. Corrections were made to account for this effect. This correction was largest at 40° where it was 6.9%. Corrections were also made for geometrical effects and for slit and contamination scattering.

The differential cross sections in the center of mass coordinate system which have been obtained are given in the table as a function of the angle through which the particles are deflected in the center of mass system. Each point was based on approximately 5,000 tracks. The limits given with the cross sections are due to statistics while the absolute values of these cross sections are believed to be good to 3.3%.

$\theta_{C.M.}$	$\sigma_{C.M.} \times 10^{24}$ cm^2	$\theta_{C.M.}$	$\sigma_{C.M.} \times 10^{24}$ cm^2
50°	0.1614 ± 0.0020	110°	0.0545 ± 0.0007
60	0.1422 ± 0.0018	120	0.0569 ± 0.0009
70	0.1165 ± 0.0016	130	0.0757 ± 0.0010
80	0.0978 ± 0.0010	140	0.1075 ± 0.0012
90	0.0763 ± 0.0009	150	0.1494 ± 0.0019
100	0.0635 ± 0.0007	155	0.1543 ± 0.0022

VITA

Franklin Alanson Rodgers was born on August 21, 1923 in Rutland, Illinois. After graduating from Chillicothe Community High School of Chillicothe, Illinois, in June 1941, he entered Bradley University in September 1941. He received his Bachelor of Science Degree in Physics from Bradley University in June 1944, having graduated with distinction and with departmental honors.

From June 1944 to September 1945 he was employed by the National Advisory Committee for Aeronautics at Cleveland, Ohio, where he did research on aircraft ignition. He entered the Graduate School of the University of Illinois in the fall of 1945. While at the University of Illinois he held a one-half time teaching assistantship for two and one-half years and a research assistantship for a semester in the Physics Department. He held a University Fellowship during his third year of graduate work.

He is co-author of the following paper: Clyde C. Swett, Jr., and Franklin A. Rodgers, *The Effect of High-Resistance Ignition Cable on the Erosion of Spark-Plug Electrodes,* NACA Memorandum Report E5121.